available bits "cb", the number of bits needed for the header "bhdr" (32 bits), the CRC checkword "bcrc" if used (16 bits), the bit allocation "bbal", and the number of bits "banc" required for ancillary data:

adb = cb - (bhdr + bcrc + bbal + banc)

The resulting number can be used to code the subband samples and the scalefactors. The principle used in the allocation procedure is minimization of the total noise-to-mask ratio over the frame with the constraint that the number of bits used does not exceed the number of bits available for that frame. Use is made of table B.2, "Layer II Possible Quantization per subband" that indicates for every subband the number of steps that may be used to quantize the samples. The number of bits required to represent these quantized samples can be derived from table B.4, "Layer II Classes of Quantization".

The allocation procedure is an iterative procedure where, in each iteration step the number of levels of the subband that has the greatest benefit is increased.

First the mask-to-noise ratio "MNR" for each subband is calculated by subtracting from the signal-to-noise-ratio "SNR" the signal-to-mask-ratio "SMR":

MNR = SNR - SMR

The signal-to-noise-ratio can be found in table C.5 "Layer II Signal-to-Noise Ratios". The signal-to-mask-ratio is the output of the psychoacoustic model.

Then zero bits are allocated to the samples and the scalefactors. The number of bits for the samples "bspl" and the number of bits for the scalefactors "bscf" are set to zero. Next an iterative procedure is started. Each iteration loop contains the following steps :

- Determination of the minimal MNR of all subbands.
- The accuracy of the quantization of the subband with the minimal MNR is increased by using the next higher entry in the relevant table B.2, "Layer II Possible Quantization per Subband".
- The new MNR of this subband is calculated.
- bspl is updated according to the additional number of bits required. If a non-zero number of bits is assigned to a subband for the first time, bsel has to be updated, and bscf has to be updated according to the number of scalefactors required for this subband. Then adb is calculated again using the formula :

  adb = cb - (bhdr + bcrc + bbal + bsel + bscf + bspl + banc)

The iterative procedure is repeated as long as adb is not less than any possible increase of bspl, bsel and bscf within one loop.

#### C.1.5.2.8 Quantization and encoding of subband samples

Each of the 12 subband samples is normalized by dividing its value by the scalefactor to obtain X and quantized using the following formula:

- Calculate A * X + B
- Take the N most significant bits.
- Invert the MSB

A and B can be found in the table C.6, "Layer II Quantization Coefficients". N represents the necessary number of bits to encode the number of steps. The inversion of the MSB is done in order to avoid the all '1' code that is used for the synchronization word.

Given the number of steps that the samples will be quantized to, table B.4, "Layer II Classes of Quantization" shows whether grouping will be used. If grouping is not required, the three samples are coded with individual codewords.

If grouping is required, three consecutive samples are coded as one codeword. Only one value $v_m$, MSB first, is transmitted for this triplet. The relationships between the coded value $v_m$ ($m$=3,5,9) and the three consecutive subband samples x, y, z are:

$v_3 = 9z + 3y + x$ ($v_3$ in 0... 26)
$v_5 = 25z + 5y + x$ ($v_5$ in 0...124)
$v_9 = 81z + 9y + x$ ($v_9$ in 0...728)

### C.1.5.2.9 Coding of bit allocation

For the purpose of a more efficient coding, only a limited number of possible quantizations, which may be different for each subband, are allowed. Only the index with wordlength "nbal" in the relevant table B.2, "Layer II Possible Quantizations per Subband" is transmitted, MSB first.

### C.1.5.2.10 Ancillary data

The Audio standard provides a number of bits for the inclusion and transmission of variable length ancillary data with the audio bitstream. The ancillary data will reduce the number of bits available for audio, which may result in a degradation of audio quality.

The presence of a bit pattern in the ancillary data matching the syncword may hamper synchronization. This problem is more likely to occur when the free format is used.

### C.1.5.2.11 Formatting

An overview of the Layer II format can be seen in figure C.3.

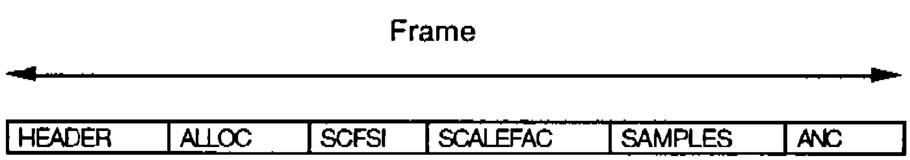


**Figure C.3 -- Layer II Format**

The differences compared to the Layer I format are:

- The length of a slot equals 8 bits.
- A new block scfsi containing the scalefactor selection information has been introduced.
- The bit allocation information, scalefactors and samples have been subject to further coding (see the relateds).

The details can be found in 2.4.1.

**Table C.4 -- Layer II scalefactor transmission patterns**

| $Class_1$ | $Class_2$ | Scalefactors used in encoder | Transmission pattern | Selection Information |
|---|---|---|---|---|
| 1 | 1 | 1 2 3 | 1 2 3 | 0 |
| 1 | 2 | 1 2 2 | 1 2 | 3 |
| 1 | 3 | 1 2 2 | 1 2 | 3 |
| 1 | 4 | 1 3 3 | 1 3 | 3 |
| 1 | 5 | 1 2 3 | 1 2 3 | 0 |
| 2 | 1 | 1 1 3 | 1 3 | 1 |
| 2 | 2 | 1 1 1 | 1 | 2 |
| 2 | 3 | 1 1 1 | 1 | 2 |
| 2 | 4 | 4 4 4 | 4 | 2 |
| 2 | 5 | 1 1 3 | 1 3 | 1 |
| 3 | 1 | 1 1 1 | 1 | 2 |
| 3 | 2 | 1 1 1 | 1 | 2 |
| 3 | 3 | 1 1 1 | 1 | 2 |
| 3 | 4 | 3 3 3 | 3 | 2 |
| 3 | 5 | 1 1 3 | 1 3 | 1 |
| 4 | 1 | 2 2 2 | 2 | 2 |
| 4 | 2 | 2 2 2 | 2 | 2 |
| 4 | 3 | 2 2 2 | 2 | 2 |
| 4 | 4 | 3 3 3 | 3 | 2 |
| 4 | 5 | 1 2 3 | 1 2 3 | 0 |
| 5 | 1 | 1 2 3 | 1 2 3 | 0 |
| 5 | 2 | 1 2 2 | 1 2 | 3 |
| 5 | 3 | 1 2 2 | 1 2 | 3 |
| 5 | 4 | 1 3 3 | 1 3 | 3 |
| 5 | 5 | 1 2 3 | 1 2 3 | 0 |

**Table C.5 -- Layer II Signal-to-Noise Ratios**

| No. of steps | SNR (dB) |
|---|---|
| 0 | 0,00 |
| 3 | 7,00 |
| 5 | 11,00 |
| 7 | 16,00 |
| 9 | 20,84 |
| 15 | 25,28 |
| 31 | 31,59 |
| 63 | 37,75 |
| 127 | 43,84 |
| 255 | 49,89 |
| 511 | 55,93 |
| 1 023 | 61,96 |
| 2 047 | 67,98 |
| 4 095 | 74,01 |
| 8 191 | 80,03 |
| 16 383 | 86,05 |
| 32 767 | 92,01 |
| 65 535 | 98,01 |

**Table C.6 -- Layer II quantization coefficients**

| No. of steps | A | B |
|---|---|---|
| 3 | 0,750000000 | -0,250000000 |
| 5 | 0,625000000 | -0,375000000 |
| 7 | 0,875000000 | -0,125000000 |
| 9 | 0,562500000 | -0,437500000 |
| 15 | 0,937500000 | -0,062500000 |
| 31 | 0,968750000 | -0,031250000 |
| 63 | 0,984375000 | -0,015625000 |
| 127 | 0,992187500 | -0,007812500 |
| 255 | 0,996093750 | -0,003906250 |
| 511 | 0,998046875 | -0,001953125 |
| 1 023 | 0,999023438 | -0,000976563 |
| 2 047 | 0,999511719 | -0,000488281 |
| 4 095 | 0,999755859 | -0,000244141 |
| 8 191 | 0,999877930 | -0,000122070 |
| 16 383 | 0,999938965 | -0,000061035 |
| 32 767 | 0,999969482 | -0,000030518 |
| 65 535 | 0,999984741 | -0,000015259 |

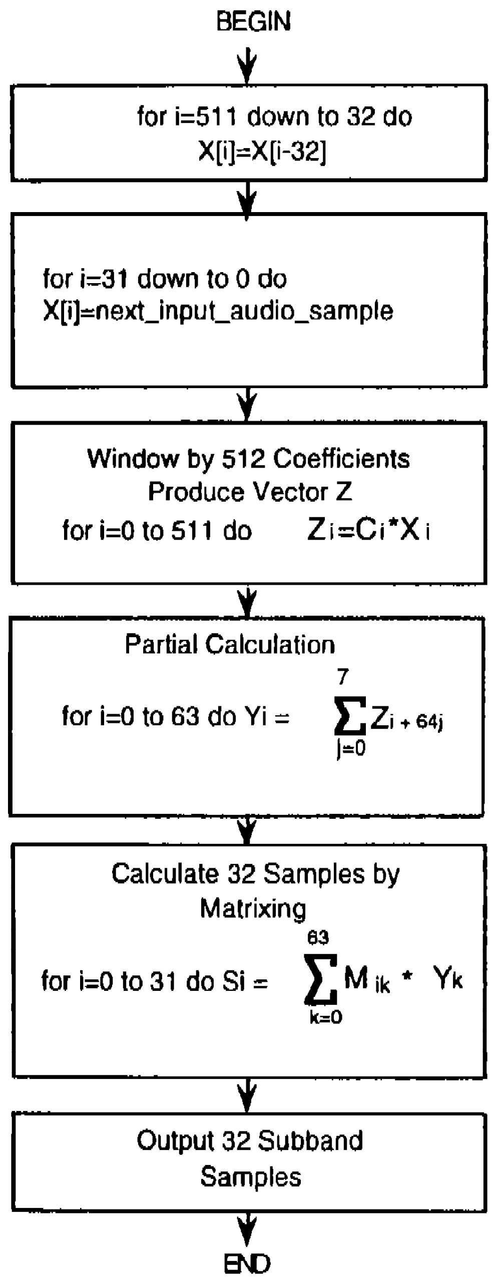


**Figure C.4 -- Analysis subband filter flow chart**

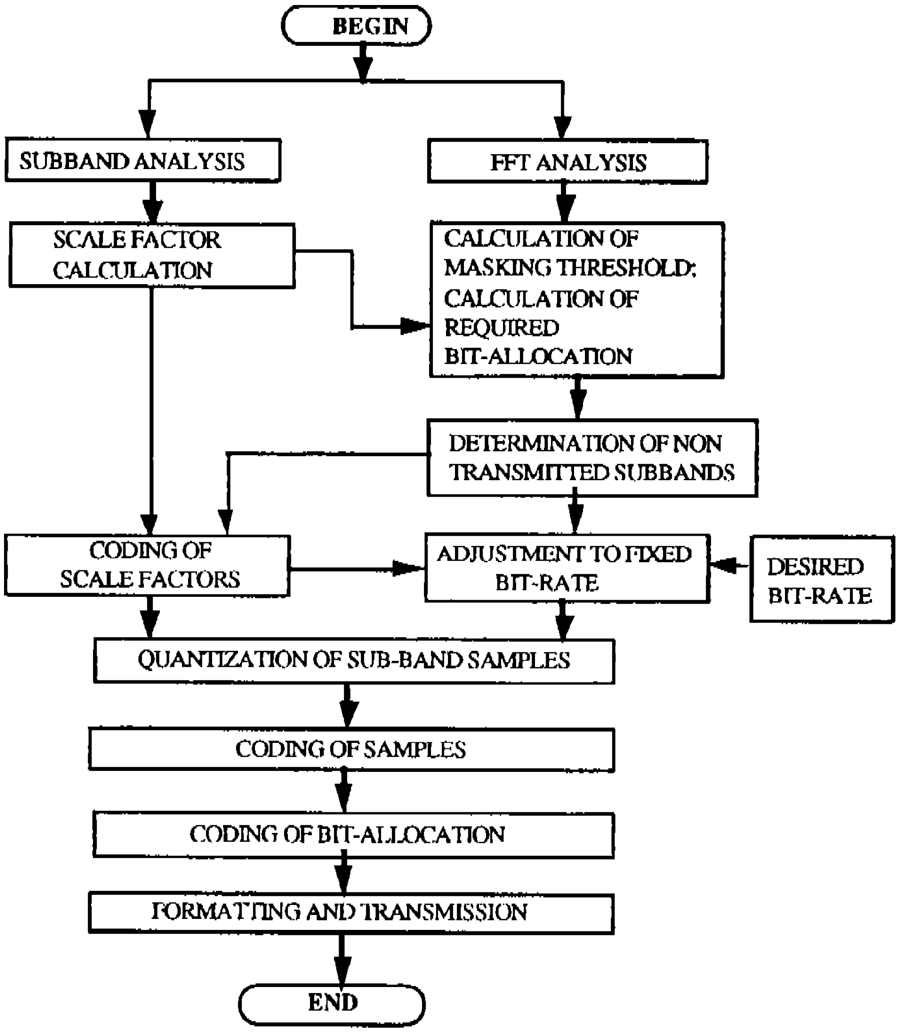


**Figure C.5 -- Layer I, II Encoder flow chart**

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### C.1.5.3 Layer III encoding

#### C.1.5.3.1 Introduction

This clause describes a possible Layer III encoding method. The basic data flow is described by the general psychoacoustic coder block diagram. The basic blocks are described in more detail and below.

#### C.1.5.3.2 Psychoacoustic model

The calculation of the psychoacoustic parameters can be done either with Psychoacoustic Model I described in clause D.1, or with Psychoacoustic Model 2 described in clause D.2. A description of modifications to Psychoacoustic Model 2 for use with Layer III can be found below. The model is run twice per block, using a shift length of 576 samples. A signal-to-mask-ratio is provided for every scalefactor band.

##### *C.1.5.3.2.1 Adaptation of psychoacoustic model II for Layer III*

Psychoacoustic Model 2 (clause D.2) is modified as described below for the use with Layer III encoding.

**General considerations:**

The model is calculated twice in parallel. One computation is done with a shift length **iblen** of 192 samples (to be used with short blocks), the other is done with a shift length of 576 samples. For the shift length of 192 samples the block length of the FFT is changed to 256, and the parameters changed accordingly.

Change to unpredictability calculation:

The calculation of the unpredictability metric in Psychoacoustic Model 2 is changed.

- Calculation of the unpredictability:
  The unpredictability cw is calculated for the first 206 spectral lines. For the other spectral lines, the unpredictability is set to 0,4.
  The unpredictability for the first 6 lines is calculated from the long FFT (window length = 1024, shiftlen = 576). For the spectral lines 6 up to 205, the unpredictability is calculated from the short FFT (window length 256, shiftlen = 192):

$$cw(w) = \begin{cases} cw\_l(w) & \text{for} \quad 0 \le w < 6 \\ cw\_s((w+2)DIV4) & \text{for} \quad 6 \le w < 206 \\ 0{,}4 & \text{for} \quad w \ge 206 \end{cases}$$

  cw_l is the unpredictability calculated from the long FFT, cw_s is the unpredictability calculated from the second short block out of three short blocks within one granule.

- The spreading function has been replaced:

  If $j \ge i$ tmpy= 3,0 (j -i)
  else tmpy= 1,5(j-i) is used.

  Only values of the spreading function greater than $10^{-6}$ are used. All other values are set to zero.

- For converting the unpredictability the parameters

  conv1 = -0,299
  conv2 = - 0,43

  are used.

- The parameter NMT (noise masking tone) is set to 6,0 dB for all threshold calculation partions. The parameter TMN (tone masking noise) is set to 29,0 dB for all partitions.
  For minval see table "threshold calculation partitions" (table C.7).

- The psychoacoustic entropy is estimated from the ratio thr/eb, where thr is the threshold and eb is the energy:

  $$pe = -\sum (cbwidth_k \cdot \log(thr_k/(eb_k+1.)))$$

  where k indexes the threshold calculation partitions and cbwidth is the width of the threshold calculation partition (see tables).

- pre-echo control

  The following constants are used for the control of pre-echo's (see block diagram):
  rpelev = 2
  rpelev2 = 16

- The threshold is not spread over the FFT lines. The threshold calculation partitions are converted directly to scalefactor bands. The first partition which is added to the scalefactor band is weighted with w1, the last with w2 (see table C.8 "Converting Threshold Calculation Partitions to Scalefactor Bands"). The table contains also the number of partitions (cbw) converted to one scalefactor band (excluding the first and the last partition).

  The parameters bo and bu are shown in table C.8. They are used for converting threshold calculation partitions to scalefactor bands.

- For short blocks a simplified version of the threshold calculation (constant signal to noise ratio) is used. The constants can be found in the columns labelled "SNR (dB)" in table C.7(def) below.

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**Table C.7 -- Threshold calculation partitions with following parameters width, minval, threshold in quiet, norm and bval:**

**Table C.7.a -- Sampling_frequency = 48 kHz long blocks**

| no. | FFT-lines | minval | qthr | norm | bval |
|---|---|---|---|---|---|
| 0 | 1 | 24,5 | 4,532 | 0,970 | 0,000 |
| 1 | 1 | 24,5 | 4,532 | 0,755 | 0,469 |
| 2 | 1 | 24,5 | 4,532 | 0,738 | 0,937 |
| 3 | 1 | 24,5 | 0,904 | 0,730 | 1,406 |
| 4 | 1 | 24,5 | 0,904 | 0,724 | 1,875 |
| 5 | 1 | 20 | 0,090 | 0,723 | 2,344 |
| 6 | 1 | 20 | 0,090 | 0,723 | 2,812 |
| 7 | 1 | 20 | 0,029 | 0,723 | 3,281 |
| 8 | 1 | 20 | 0,029 | 0,718 | 3,750 |
| 9 | 1 | 20 | 0,009 | 0,690 | 4,199 |
| 10 | 1 | 20 | 0,009 | 0,660 | 4,625 |
| 11 | 1 | 18 | 0,009 | 0,641 | 5,047 |
| 12 | 1 | 18 | 0,009 | 0,600 | 5,437 |
| 13 | 1 | 18 | 0,009 | 0,584 | 5,828 |
| 14 | 1 | 12 | 0,009 | 0,531 | 6.187 |
| 15 | 1 | 12 | 0,009 | 0,537 | 6,522 |
| 16 | 2 | 6 | 0,018 | 0,857 | 7,174 |
| 17 | 2 | 6 | 0,018 | 0,858 | 7,800 |
| 18 | 2 | 3 | 0,018 | 0,853 | 8,402 |
| 19 | 2 | 3 | 0,018 | 0,824 | 8,966 |
| 20 | 2 | 3 | 0,018 | 0,778 | 9,483 |
| 21 | 2 | 3 | 0,018 | 0,740 | 9,966 |
| 22 | 2 | 0 | 0,018 | 0,709 | 10,426 |
| 23 | 2 | 0 | 0,018 | 0,676 | 10,866 |
| 24 | 2 | 0 | 0,018 | 0,632 | 11.279 |
| 25 | 2 | 0 | 0,018 | 0,592 | 11,669 |
| 26 | 2 | 0 | 0,018 | 0,553 | 12,042 |
| 27 | 2 | 0 | 0,018 | 0,510 | 12,386 |
| 28 | 2 | 0 | 0,018 | 0,513 | 12,721 |
| 29 | 3 | 0 | 0,027 | 0,608 | 13,115 |
| 30 | 3 | 0 | 0,027 | 0,673 | 13,561 |
| 31 | 3 | 0 | 0,027 | 0,636 | 13,983 |
| 32 | 3 | 0 | 0,027 | 0,586 | 14,371 |
| 33 | 3 | 0 | 0,027 | 0,571 | 14,741 |
| 34 | 4 | 0 | 0,036 | 0,616 | 15,140 |
| 35 | 4 | 0 | 0,036 | 0,640 | 15,562 |
| 36 | 4 | 0 | 0,036 | 0,597 | 15,962 |
| 37 | 4 | 0 | 0,036 | 0,538 | 16,324 |
| 38 | 4 | 0 | 0,036 | 0,512 | 16,665 |
| 39 | 5 | 0 | 0,045 | 0,528 | 17,020 |
| 40 | 5 | 0 | 0,045 | 0,516 | 17,373 |
| 41 | 5 | 0 | 0,045 | 0,493 | 17,708 |
| 42 | 6 | 0 | 0,054 | 0,499 | 18,045 |
| 43 | 7 | 0 | 0,063 | 0,525 | 18,398 |
| 44 | 7 | 0 | 0,063 | 0,541 | 18,762 |
| 45 | 8 | 0 | 0,072 | 0,528 | 19,120 |
| 46 | 8 | 0 | 0,072 | 0,510 | 19,466 |
| 47 | 8 | 0 | 0,072 | 0,506 | 19,807 |
| 48 | 10 | 0 | 0,180 | 0,525 | 20,159 |
| 49 | 10 | 0 | 0,180 | 0,536 | 20,522 |
| 50 | 10 | 0 | 0,180 | 0,518 | 20,873 |
| 51 | 13 | 0 | 0,372 | 0,501 | 21,214 |
| 52 | 13 | 0 | 0,372 | 0,496 | 21,553 |
| 53 | 14 | 0 | 0,400 | 0,497 | 21,892 |
| 54 | 18 | 0 | 1,628 | 0,495 | 22,231 |
| 55 | 18 | 0 | 1,628 | 0,494 | 22,569 |
| 56 | 20 | 0 | 1,808 | 0,497 | 22,909 |
| 57 | 25 | 0 | 22,607 | 0,494 | 23,248 |
| 58 | 25 | 0 | 22,607 | 0,487 | 23,583 |
| 59 | 35 | 0 | 31,650 | 0,483 | 23,915 |
| 60 | 67 | 0 | 605,867 | 0,482 | 24,246 |
| 61 | 67 | 0 | 605.867 | 0,524 | 24,576 |

Table C.7.b Sampling_frequency = 44,1 kHz long blocks

| no. | FFT-lines | minval | qthr | norm | bval |
|---|---|---|---|---|---|
| 0 | 1 | 24,5 | 4,532 | 0,951 | 0,000 |
| 1 | 1 | 24,5 | 4,532 | 0,700 | 0,431 |
| 2 | 1 | 24,5 | 4,532 | 0,681 | 0,861 |
| 3 | 1 | 24,5 | 0,904 | 0,675 | 1,292 |
| 4 | 1 | 24,5 | 0,904 | 0,667 | 1,723 |
| 5 | 1 | 20 | 0,090 | 0,665 | 2,153 |
| 6 | 1 | 20 | 0,090 | 0,664 | 2,584 |
| 7 | 1 | 20 | 0,029 | 0,664 | 3,015 |
| 8 | 1 | 20 | 0,029 | 0,664 | 3,445 |
| 9 | 1 | 20 | 0,029 | 0,655 | 3,876 |
| 10 | 1 | 20 | 0,009 | 0,616 | 4,279 |
| 11 | 1 | 20 | 0,009 | 0,597 | 4,670 |
| 12 | 1 | 18 | 0,009 | 0,578 | 5,057 |
| 13 | 1 | 18 | 0,009 | 0,541 | 5,415 |
| 14 | 1 | 18 | 0,009 | 0,575 | 5,774 |
| 15 | 2 | 12 | 0,018 | 0,856 | 6,422 |
| 16 | 2 | 6 | 0,018 | 0,846 | 7,026 |
| 17 | 2 | 6 | 0,018 | 0,840 | 7,609 |
| 18 | 2 | 3 | 0,018 | 0,822 | 8,168 |
| 19 | 2 | 3 | 0,018 | 0,800 | 8,710 |
| 20 | 2 | 3 | 0,018 | 0,753 | 9,207 |
| 21 | 2 | 3 | 0,018 | 0,704 | 9,662 |
| 22 | 2 | 0 | 0,018 | 0,674 | 10,099 |
| 23 | 2 | 0 | 0,018 | 0,640 | 10,515 |
| 24 | 2 | 0 | 0,018 | 0,609 | 10,917 |
| 25 | 2 | 0 | 0,018 | 0,566 | 11,293 |
| 26 | 2 | 0 | 0,018 | 0,535 | 11,652 |
| 27 | 2 | 0 | 0,018 | 0,531 | 11,997 |
| 28 | 3 | 0 | 0,027 | 0,615 | 12,394 |
| 29 | 3 | 0 | 0,027 | 0,686 | 12,850 |
| 30 | 3 | 0 | 0,027 | 0,650 | 13,277 |
| 31 | 3 | 0 | 0,027 | 0,611 | 13,681 |
| 32 | 3 | 0 | 0,027 | 0,567 | 14,062 |
| 33 | 3 | 0 | 0,027 | 0,520 | 14,411 |
| 34 | 3 | 0 | 0,027 | 0,513 | 14,751 |
| 35 | 4 | 0 | 0,036 | 0,557 | 15,119 |
| 36 | 4 | 0 | 0,036 | 0,584 | 15,508 |
| 37 | 4 | 0 | 0,036 | 0,570 | 15,883 |
| 38 | 5 | 0 | 0,045 | 0,579 | 16,263 |
| 39 | 5 | 0 | 0,045 | 0,585 | 16,654 |
| 40 | 5 | 0 | 0,045 | 0,548 | 17,020 |
| 41 | 6 | 0 | 0,054 | 0,536 | 17,374 |
| 42 | 6 | 0 | 0,054 | 0,550 | 17,744 |
| 43 | 7 | 0 | 0,063 | 0,532 | 18,104 |
| 44 | 7 | 0 | 0,063 | 0,504 | 18,447 |
| 45 | 7 | 0 | 0,063 | 0,496 | 18,781 |
| 46 | 9 | 0 | 0,081 | 0,516 | 19,130 |
| 47 | 9 | 0 | 0,081 | 0,527 | 19,487 |
| 48 | 9 | 0 | 0,081 | 0,516 | 19,838 |
| 49 | 10 | 0 | 0,180 | 0,497 | 20,179 |
| 50 | 10 | 0 | 0,180 | 0,489 | 20,510 |
| 51 | 11 | 0 | 0,198 | 0,502 | 20,852 |
| 52 | 14 | 0 | 0,400 | 0,502 | 21,196 |
| 53 | 14 | 0 | 0,400 | 0,491 | 21,531 |
| 54 | 15 | 0 | 0,429 | 0,497 | 21,870 |
| 55 | 20 | 0 | 1,808 | 0,504 | 22,214 |
| 56 | 20 | 0 | 1,808 | 0,504 | 22,558 |
| 57 | 21 | 0 | 1,899 | 0,495 | 22,898 |
| 58 | 27 | 0 | 24,415 | 0,486 | 23,232 |
| 59 | 27 | 0 | 24,415 | 0,484 | 23,564 |
| 60 | 36 | 0 | 32,554 | 0,483 | 23,897 |
| 61 | 73 | 0 | 660,124 | 0,475 | 24,229 |
| 62 | 18 | 0 | 162,770 | 0,515 | 24,542 |

Table C.7.c -- Sampling_frequency = 32 kHz long blocks

| no. | FFT-lines | minval | qthr | norm | bval |
|---|---|---|---|---|---|
| 0 | 2 | 24,5 | 9,064 | 0,997 | 0,312 |
| 1 | 2 | 24,5 | 9,064 | 0,893 | 0,937 |
| 2 | 2 | 24,5 | 1,808 | 0,881 | 1,562 |
| 3 | 2 | 20 | 0,181 | 0,873 | 2,187 |
| 4 | 2 | 20 | 0,181 | 0,872 | 2,812 |
| 5 | 2 | 20 | 0,057 | 0,871 | 3,437 |
| 6 | 2 | 20 | 0,018 | 0,860 | 4,045 |
| 7 | 2 | 20 | 0,018 | 0,839 | 4,625 |
| 8 | 2 | 18 | 0,018 | 0,812 | 5,173 |
| 9 | 2 | 18 | 0,018 | 0,784 | 5,698 |
| 10 | 2 | 12 | 0,018 | 0,741 | 6,184 |
| 11 | 2 | 12 | 0,018 | 0,697 | 6,634 |
| 12 | 2 | 6 | 0,018 | 0,674 | 7,070 |
| 13 | 2 | 6 | 0,018 | 0,651 | 7,492 |
| 14 | 2 | 6 | 0,018 | 0,633 | 7,905 |
| 15 | 2 | 3 | 0,018 | 0,611 | 8,305 |
| 16 | 2 | 3 | 0,018 | 0,589 | 8,695 |
| 17 | 2 | 3 | 0,018 | 0,575 | 9,064 |
| 18 | 3 | 3 | 0,027 | 0,654 | 9,483 |
| 19 | 3 | 3 | 0,027 | 0,724 | 9,966 |
| 20 | 3 | 0 | 0,027 | 0,701 | 10,425 |
| 21 | 3 | 0 | 0,027 | 0,673 | 10,866 |
| 22 | 3 | 0 | 0,027 | 0,631 | 11,279 |
| 23 | 3 | 0 | 0,027 | 0,592 | 11,669 |
| 24 | 3 | 0 | 0,027 | 0,553 | 12,042 |
| 25 | 3 | 0 | 0,027 | 0,510 | 12,386 |
| 26 | 3 | 0 | 0,027 | 0,505 | 12,721 |
| 27 | 4 | 0 | 0,036 | 0,562 | 13,091 |
| 28 | 4 | 0 | 0,036 | 0,598 | 13,488 |
| 29 | 4 | 0 | 0,036 | 0,589 | 13,873 |
| 30 | 5 | 0 | 0,045 | 0,607 | 14,268 |
| 31 | 5 | 0 | 0,045 | 0,620 | 14,679 |
| 32 | 5 | 0 | 0,045 | 0,580 | 15,067 |
| 33 | 5 | 0 | 0,045 | 0,532 | 15,424 |
| 34 | 5 | 0 | 0,045 | 0,517 | 15,771 |
| 35 | 6 | 0 | 0,054 | 0,517 | 16,120 |
| 36 | 6 | 0 | 0,054 | 0,509 | 16,466 |
| 37 | 6 | 0 | 0,054 | 0,506 | 16,807 |
| 38 | 8 | 0 | 0,072 | 0,522 | 17,158 |
| 39 | 8 | 0 | 0,072 | 0,531 | 17,518 |
| 40 | 8 | 0 | 0,072 | 0,519 | 17,869 |
| 41 | 10 | 0 | 0,090 | 0,512 | 18,215 |
| 42 | 10 | 0 | 0,090 | 0,509 | 18,562 |
| 43 | 10 | 0 | 0,090 | 0,497 | 18,902 |
| 44 | 12 | 0 | 0,108 | 0,494 | 19,239 |
| 45 | 12 | 0 | 0,108 | 0,501 | 19,579 |
| 46 | 13 | 0 | 0,117 | 0,507 | 19,925 |
| 47 | 14 | 0 | 0,252 | 0,502 | 20,269 |
| 48 | 14 | 0 | 0,252 | 0,493 | 20,606 |
| 49 | 16 | 0 | 0,289 | 0,497 | 20,944 |
| 50 | 20 | 0 | 0,572 | 0,506 | 21,288 |
| 51 | 20 | 0 | 0,572 | 0,510 | 21,635 |
| 52 | 23 | 0 | 0,658 | 0,504 | 21,979 |
| 53 | 27 | 0 | 2,441 | 0,496 | 22,319 |
| 54 | 27 | 0 | 2,441 | 0,493 | 22,656 |
| 55 | 32 | 0 | 2,894 | 0,490 | 22,993 |
| 56 | 37 | 0 | 33,458 | 0,483 | 23,326 |
| 57 | 37 | 0 | 33,458 | 0,458 | 23,656 |
| 58 | 12 | 0 | 10,851 | 0,500 | 23,937 |

**Table C.7.d -- Sampling_frequency = 48 kHz short blocks**

| no. | FFT-lines | qthr | norm | SNR (db) | bval |
|---|---|---|---|---|---|
| 0 | 1 | 4,532 | 0,970 | -8,240 | 0,000 |
| 1 | 1 | 0,904 | 0,755 | -8,240 | 1,875 |
| 2 | 1 | 0,029 | 0,738 | -8,240 | 3,750 |
| 3 | 1 | 0,009 | 0,730 | -8,240 | 5,437 |
| 4 | 1 | 0,009 | 0,724 | -8,240 | 6,857 |
| 5 | 1 | 0,009 | 0,723 | -8,240 | 8,109 |
| 6 | 1 | 0,009 | 0,723 | -8,240 | 9,237 |
| 7 | 1 | 0,009 | 0,723 | -8,240 | 10,202 |
| 8 | 1 | 0,009 | 0,718 | -8,240 | 11,083 |
| 9 | 1 | 0,009 | 0,690 | -8,240 | 11,864 |
| 10 | 1 | 0,009 | 0,660 | -7,447 | 12,553 |
| 11 | 1 | 0,009 | 0,641 | -7,447 | 13,195 |
| 12 | 1 | 0,009 | 0,600 | -7,447 | 13,781 |
| 13 | 1 | 0,009 | 0,584 | -7,447 | 14,309 |
| 14 | 1 | 0,009 | 0,532 | -7,447 | 14,803 |
| 15 | 1 | 0,009 | 0,537 | -7,447 | 15,250 |
| 16 | 1 | 0,009 | 0,857 | -7,447 | 15,667 |
| 17 | 1 | 0,009 | 0,858 | -7,447 | 16,068 |
| 18 | 1 | 0,009 | 0,853 | -7,447 | 16,409 |
| 19 | 2 | 0,018 | 0,824 | -7,447 | 17,044 |
| 20 | 2 | 0,018 | 0,778 | -6,990 | 17,607 |
| 21 | 2 | 0,018 | 0,740 | -6,990 | 18,097 |
| 22 | 2 | 0,018 | 0,709 | -6,990 | 18,528 |
| 23 | 2 | 0,018 | 0,676 | -6,990 | 18,930 |
| 24 | 2 | 0,018 | 0,632 | -6,990 | 19,295 |
| 25 | 2 | 0,018 | 0,592 | -6,990 | 19,636 |
| 26 | 3 | 0,054 | 0,553 | -6,990 | 20,038 |
| 27 | 3 | 0,054 | 0,510 | -6,990 | 20,486 |
| 28 | 3 | 0,054 | 0,513 | -6,990 | 20,900 |
| 29 | 4 | 0,114 | 0,608 | -6,990 | 21,305 |
| 30 | 4 | 0,114 | 0,673 | -6,020 | 21,722 |
| 31 | 5 | 0,452 | 0,637 | -6,020 | 22,128 |
| 32 | 5 | 0,452 | 0,586 | -6,020 | 22,512 |
| 33 | 5 | 0,452 | 0,571 | -6,020 | 22,877 |
| 34 | 7 | 6,330 | 0,616 | -5,229 | 23,241 |
| 35 | 7 | 6,330 | 0,640 | -5,229 | 23,616 |
| 36 | 11 | 9,947 | 0,597 | -5,229 | 23,974 |
| 37 | 17 | 153,727 | 0,538 | -5,229 | 24,312 |

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Table C.7.e -- Sampling_frequency = 44,1 kHz short blocks

| no. | FFT-lines | qthr | norm | SNR (db) | bval |
|---|---|---|---|---|---|
| 0 | 1 | 4,532 | 0,952 | -8,240 | 0,000 |
| 1 | 1 | 0,904 | 0,700 | -8,240 | 1,723 |
| 2 | 1 | 0,029 | 0,681 | -8,240 | 3,445 |
| 3 | 1 | 0,009 | 0,675 | -8,240 | 5,057 |
| 4 | 1 | 0,009 | 0,667 | -8,240 | 6,422 |
| 5 | 1 | 0,009 | 0,665 | -8,240 | 7,609 |
| 6 | 1 | 0,009 | 0,664 | -8,240 | 8,710 |
| 7 | 1 | 0,009 | 0,664 | -8,240 | 9,662 |
| 8 | 1 | 0,009 | 0,664 | -8,240 | 10,515 |
| 9 | 1 | 0,009 | 0,655 | -8,240 | 11,293 |
| 10 | 1 | 0,009 | 0,616 | -7,447 | 12,009 |
| 11 | 1 | 0,009 | 0,597 | -7,447 | 12,625 |
| 12 | 1 | 0,009 | 0,578 | -7,447 | 13,210 |
| 13 | 1 | 0,009 | 0,541 | -7,447 | 13,748 |
| 14 | 1 | 0,009 | 0,575 | -7,447 | 14,241 |
| 15 | 1 | 0,009 | 0,856 | -7,447 | 14,695 |
| 16 | 1 | 0,009 | 0,846 | -7,447 | 15,125 |
| 17 | 1 | 0,009 | 0,840 | -7,447 | 15,508 |
| 18 | 1 | 0,009 | 0,822 | -7,447 | 15,891 |
| 19 | 2 | 0,018 | 0,800 | -7,447 | 16,537 |
| 20 | 2 | 0,018 | 0,753 | -6,990 | 17,112 |
| 21 | 2 | 0,018 | 0,704 | -6,990 | 17,620 |
| 22 | 2 | 0,018 | 0,674 | -6,990 | 18,073 |
| 23 | 2 | 0,018 | 0,640 | -6,990 | 18,470 |
| 24 | 2 | 0,018 | 0,609 | -6,990 | 18,849 |
| 25 | 3 | 0,027 | 0,566 | -6,990 | 19,271 |
| 26 | 3 | 0,027 | 0,535 | -6,990 | 19,741 |
| 27 | 3 | 0,054 | 0,531 | -6,990 | 20,177 |
| 28 | 3 | 0,054 | 0,615 | -6,990 | 20,576 |
| 29 | 3 | 0,054 | 0,686 | -6,990 | 20,950 |
| 30 | 4 | 0,114 | 0,650 | -6,020 | 21,316 |
| 31 | 4 | 0,114 | 0,612 | -6,020 | 21,699 |
| 32 | 5 | 0,452 | 0,567 | -6,020 | 22,078 |
| 33 | 5 | 0,452 | 0,520 | -6,020 | 22,438 |
| 34 | 5 | 0,452 | 0,513 | -5,229 | 22,782 |
| 35 | 7 | 6,330 | 0,557 | -5,229 | 23,133 |
| 36 | 7 | 6,330 | 0,584 | -5,229 | 23,484 |
| 37 | 7 | 6,330 | 0,570 | -5,229 | 23,828 |
| 38 | 19 | 171,813 | 0,578 | -4,559 | 24,173 |

Table C.7.f -- Sampling_frequency = 32 kHz short blocks

| no. | FFT-lines | qthr | norm | SNR (db) | bval |
|---|---|---|---|---|---|
| 0 | 1 | 4,532 | 0,997 | -8,240 | 0,000 |
| 1 | 1 | 0,904 | 0,893 | -8,240 | 1,250 |
| 2 | 1 | 0,090 | 0,881 | -8,240 | 2,500 |
| 3 | 1 | 0,029 | 0,873 | -8,240 | 3,750 |
| 4 | 1 | 0,009 | 0,872 | -8,240 | 4,909 |
| 5 | 1 | 0,009 | 0,871 | -8,240 | 5,958 |
| 6 | 1 | 0,009 | 0,860 | -8,240 | 6,857 |
| 7 | 1 | 0,009 | 0,839 | -8,240 | 7,700 |
| 8 | 1 | 0,009 | 0,812 | -8,240 | 8,500 |
| 9 | 1 | 0,009 | 0,784 | -8,240 | 9,237 |
| 10 | 1 | 0,009 | 0,741 | -7,447 | 9,895 |
| 11 | 1 | 0,009 | 0,697 | -7,447 | 10,500 |
| 12 | 1 | 0,009 | 0,674 | -7,447 | 11,083 |
| 13 | 1 | 0,009 | 0,651 | -7,447 | 11,604 |
| 14 | 1 | 0,009 | 0,633 | -7,447 | 12,107 |
| 15 | 1 | 0,009 | 0,611 | -7,447 | 12,554 |
| 16 | 1 | 0,009 | 0,589 | -7,447 | 13,000 |
| 17 | 1 | 0,009 | 0,575 | -7,447 | 13,391 |
| 18 | 1 | 0,009 | 0,654 | -7,447 | 13,781 |
| 19 | 2 | 0,018 | 0,724 | -7,447 | 14,474 |
| 20 | 2 | 0,018 | 0,701 | -6,990 | 15,096 |
| 21 | 2 | 0,018 | 0,673 | -6,990 | 15,667 |
| 22 | 2 | 0,018 | 0,631 | -6,990 | 16,177 |
| 23 | 2 | 0,018 | 0,592 | -6,990 | 16,636 |
| 24 | 2 | 0,018 | 0,553 | -6,990 | 17,057 |
| 25 | 2 | 0,018 | 0,510 | -6,990 | 17,429 |
| 26 | 2 | 0,018 | 0,506 | -6,990 | 17,786 |
| 27 | 3 | 0,027 | 0,562 | -6,990 | 18,177 |
| 28 | 3 | 0,027 | 0,598 | -6,990 | 18,597 |
| 29 | 3 | 0,027 | 0,589 | -6,990 | 18,994 |
| 30 | 3 | 0,027 | 0,607 | -6,020 | 19,352 |
| 31 | 3 | 0,027 | 0,620 | -6,020 | 19,693 |
| 32 | 4 | 0,072 | 0,580 | -6,020 | 20,066 |
| 33 | 4 | 0,072 | 0,532 | -6,020 | 20,461 |
| 34 | 4 | 0,072 | 0,517 | -5,229 | 20,841 |
| 35 | 5 | 0,143 | 0,517 | -5,229 | 21,201 |
| 36 | 5 | 0,143 | 0,509 | -5,229 | 21,549 |
| 37 | 6 | 0,172 | 0,506 | -5,229 | 21,911 |
| 38 | 7 | 0,633 | 0,522 | -4,559 | 22,275 |
| 39 | 7 | 0,633 | 0,531 | -4,559 | 22,625 |
| 40 | 8 | 0,723 | 0,519 | -3,980 | 22,971 |
| 41 | 10 | 9,043 | 0,512 | -3,980 | 23,321 |

**Table C.8 -- Tables for converting threshold calculation partitions to scalefactor bands**

**Table C.8.a -- Sampling_frequency = 48 kHz long blocks**

| no. sb | cbw | bu | bo | w1 | w2 |
|---|---|---|---|---|---|
| 0 | 3 | 0 | 4 | 1,000 | 0,056 |
| 1 | 3 | 4 | 7 | 0,944 | 0,611 |
| 2 | 4 | 7 | 11 | 0,389 | 0,167 |
| 3 | 3 | 11 | 14 | 0,833 | 0,722 |
| 4 | 3 | 14 | 17 | 0,278 | 0,639 |
| 5 | 2 | 17 | 19 | 0,361 | 0,417 |
| 6 | 3 | 19 | 22 | 0,583 | 0,083 |
| 7 | 2 | 22 | 24 | 0,917 | 0,750 |
| 8 | 3 | 24 | 27 | 0,250 | 0,417 |
| 9 | 3 | 27 | 30 | 0,583 | 0,648 |
| 10 | 3 | 30 | 33 | 0,352 | 0,611 |
| 11 | 3 | 33 | 36 | 0,389 | 0,625 |
| 12 | 4 | 36 | 40 | 0,375 | 0,144 |
| 13 | 3 | 40 | 43 | 0,856 | 0,389 |
| 14 | 3 | 43 | 46 | 0,611 | 0,160 |
| 15 | 3 | 46 | 49 | 0,840 | 0,217 |
| 16 | 3 | 49 | 52 | 0,783 | 0,184 |
| 17 | 2 | 52 | 54 | 0,816 | 0,886 |
| 18 | 3 | 54 | 57 | 0,114 | 0,313 |
| 19 | 2 | 57 | 59 | 0,687 | 0,452 |
| 20 | 1 | 59 | 60 | 0,548 | 0,908 |

**Table C.8.b -- Sampling_frequency = 44,1 kHz long blocks**

| no. sb | cbw | bu | bo | w1 | w2 |
|---|---|---|---|---|---|
| 0 | 3 | 0 | 4 | 1,000 | 0,056 |
| 1 | 3 | 4 | 7 | 0,944 | 0,611 |
| 2 | 4 | 7 | 11 | 0,389 | 0,167 |
| 3 | 3 | 11 | 14 | 0,833 | 0,722 |
| 4 | 3 | 14 | 17 | 0,278 | 0,139 |
| 5 | 1 | 17 | 18 | 0,861 | 0,917 |
| 6 | 3 | 18 | 21 | 0,083 | 0,583 |
| 7 | 3 | 21 | 24 | 0,417 | 0,250 |
| 8 | 3 | 24 | 27 | 0,750 | 0,805 |
| 9 | 3 | 27 | 30 | 0,194 | 0,574 |
| 10 | 3 | 30 | 33 | 0,426 | 0,537 |
| 11 | 3 | 33 | 36 | 0,463 | 0,819 |
| 12 | 4 | 36 | 40 | 0,180 | 0,100 |
| 13 | 3 | 40 | 43 | 0,900 | 0,468 |
| 14 | 3 | 43 | 46 | 0,532 | 0,623 |
| 15 | 3 | 46 | 49 | 0,376 | 0,450 |
| 16 | 3 | 49 | 52 | 0,550 | 0,552 |
| 17 | 3 | 52 | 55 | 0,448 | 0,403 |
| 18 | 2 | 55 | 57 | 0,597 | 0,643 |
| 19 | 2 | 57 | 59 | 0,357 | 0,722 |
| 20 | 2 | 59 | 61 | 0,278 | 0,960 |

**Table C.8.c -- Sampling_frequency = 32 kHz long blocks**

| no. sb | cbw | bu | bo | w1 | w2 |
|---|---|---|---|---|---|
| 0 | 1 | 0 | 2 | 1,000 | 0,528 |
| 1 | 2 | 2 | 4 | 0,472 | 0,305 |
| 2 | 2 | 4 | 6 | 0,694 | 0,083 |
| 3 | 1 | 6 | 7 | 0,917 | 0,861 |
| 4 | 2 | 7 | 9 | 0,139 | 0,639 |
| 5 | 2 | 9 | 11 | 0,361 | 0,417 |
| 6 | 3 | 11 | 14 | 0,583 | 0,083 |
| 7 | 2 | 14 | 16 | 0,917 | 0,750 |
| 8 | 3 | 16 | 19 | 0,250 | 0,870 |
| 9 | 3 | 19 | 22 | 0,130 | 0,833 |
| 10 | 4 | 22 | 26 | 0,167 | 0,389 |
| 11 | 4 | 26 | 30 | 0,611 | 0,478 |
| 12 | 4 | 30 | 34 | 0,522 | 0,033 |
| 13 | 3 | 34 | 37 | 0,967 | 0,917 |
| 14 | 4 | 37 | 41 | 0,083 | 0,617 |
| 15 | 3 | 41 | 44 | 0,383 | 0,995 |
| 16 | 4 | 44 | 48 | 0,005 | 0,274 |
| 17 | 3 | 48 | 51 | 0,726 | 0,480 |
| 18 | 3 | 51 | 54 | 0,519 | 0,261 |
| 19 | 2 | 54 | 56 | 0,739 | 0,884 |
| 20 | 2 | 56 | 58 | 0,116 | 1,000 |

**Table C.8.d -- Sampling_frequency = 48 kHz short blocks**

| no. sb | cbw | bu | bo | w1 | w2 |
|---|---|---|---|---|---|
| 0 | 2 | 0 | 3 | 1,000 | 0,167 |
| 1 | 2 | 3 | 5 | 0,833 | 0,833 |
| 2 | 3 | 5 | 8 | 0,167 | 0,500 |
| 3 | 3 | 8 | 11 | 0,500 | 0,167 |
| 4 | 4 | 11 | 15 | 0,833 | 0,167 |
| 5 | 4 | 15 | 19 | 0,833 | 0,583 |
| 6 | 3 | 19 | 22 | 0,417 | 0,917 |
| 7 | 4 | 22 | 26 | 0,083 | 0,944 |
| 8 | 4 | 26 | 30 | 0,055 | 0,042 |
| 9 | 2 | 30 | 32 | 0,958 | 0,567 |
| 10 | 3 | 32 | 35 | 0,433 | 0,167 |
| 11 | 2 | 35 | 37 | 0,833 | 0,618 |

**Table C.8.e -- Sampling_frequency = 44,1 kHz short blocks**

| no. sb | cbw | bu | bo | w1 | w2 |
|---|---|---|---|---|---|
| 0 | 2 | 0 | 3 | 1,000 | 0,167 |
| 1 | 2 | 3 | 5 | 0,833 | 0,833 |
| 2 | 3 | 5 | 8 | 0,167 | 0,500 |
| 3 | 3 | 8 | 11 | 0,500 | 0,167 |
| 4 | 4 | 11 | 15 | 0,833 | 0,167 |
| 5 | 5 | 15 | 20 | 0,833 | 0,250 |
| 6 | 3 | 20 | 23 | 0,750 | 0,583 |
| 7 | 4 | 23 | 27 | 0,417 | 0,055 |
| 8 | 3 | 27 | 30 | 0,944 | 0,375 |
| 9 | 3 | 30 | 33 | 0,625 | 0,300 |
| 10 | 3 | 33 | 36 | 0,700 | 0,167 |
| 11 | 2 | 36 | 38 | 0,833 | 1,000 |

**Table C.8.f -- Sampling_frequency = 32 kHz short blocks**

| no. sb | cbw | bu | bo | w1 | w2 |
|---|---|---|---|---|---|
| 0 | 2 | 0 | 3 | 1,000 | 0,167 |
| 1 | 2 | 3 | 5 | 0,833 | 0,833 |
| 2 | 3 | 5 | 8 | 0,167 | 0,500 |
| 3 | 3 | 8 | 11 | 0,500 | 0,167 |
| 4 | 4 | 11 | 15 | 0,833 | 0,167 |
| 5 | 5 | 15 | 20 | 0,833 | 0,250 |
| 6 | 4 | 20 | 24 | 0,750 | 0,250 |
| 7 | 5 | 24 | 29 | 0,750 | 0,055 |
| 8 | 4 | 29 | 33 | 0,944 | 0,375 |
| 9 | 4 | 33 | 37 | 0,625 | 0,472 |
| 10 | 3 | 37 | 40 | 0,528 | 0,937 |
| 11 | 1 | 40 | 41 | 0,062 | 1,000 |

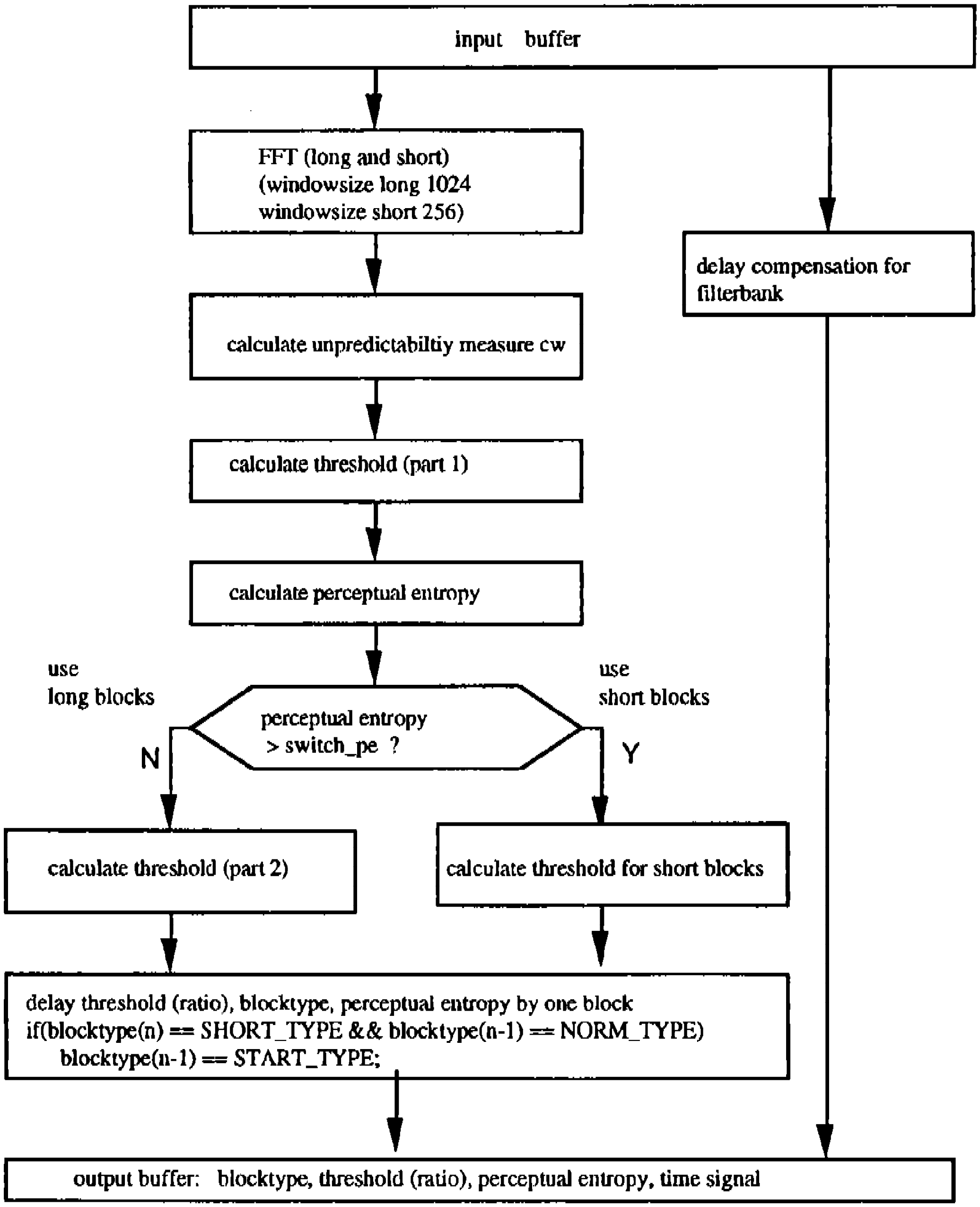


**Figure C.6.a -- Block diagram psychoacoustic model 2, Layer III: calculate threshold**

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↓

calculate the energy and the unpredictability in the threshold calculation partitions

$eb(b) = \sum r(w)^2$

$cb(b) = \sum cw(w) \cdot r(w)^2$

↓

convolve the partitioned energy and unpredictability with the spreading function

$ecbb(b) = eb * sprdngf$

$ctb(b) = cb * sprdngf$

↓

calculate the tonality of each threshold calculation partition

$tbb(b) = conv1 + conv2 \cdot \log\left( e^{\frac{ctb(b)}{ecbb(b)}} \right)$

↓

calculate the SNR in each threshhold calculation partition

$SNR(b) = MAX\,(\, minval(b),\; TMN(b) \cdot tbb(b) + NMT(b) \cdot (1 - tbb(b)\,)\,)$

↓

calculate the threshold for each partition

$nbb(b) = ecbb(b) \cdot norm(b) \cdot 10^{SNR(b)/10}$

norm(b) is a normalizing constant for each partition

↓

pre-echo control:
compare the threshold with the last threshold and the threshold in quiet and take the maximum:

$thr(b) = MAX(qthr(b), nbb(b), nbb\_l(b), nbb\_ll(b))$

$nbb\_l(b) = rpelev \cdot nbb(b)$ from the last block

$nbb\_ll(b) = rpelev2 \cdot nbb(b)$ from the block before the last block

↓

**Figure C.6.b -- Block diagram psychoacoustic model 2, Layer III: calculate threshold (part 1)**

convert from threshold calculation partitions to codec partitions (scalefactor bands):

energy in each scalefactor band:

$$en(sb) = w1 \cdot eb(bu) + \sum_{b=bu+1}^{b=bo-1} eb(b) + w2 \cdot eb(bo)$$

threshold in each scalefactor band:

$$thrn(sb) = w1 \cdot thr(bu) + \sum_{b=bu+1}^{b=bo-1} thr(b) + w2 \cdot thr(bo)$$

Calculate ratios for each scalefactor band:

$$ratio(sb) = \frac{thrn(sb)}{en(sb)}$$

**Figure C.6.c -- Block diagram psychoacoustic model 2, Layer III: calculate threshold (part 2)**